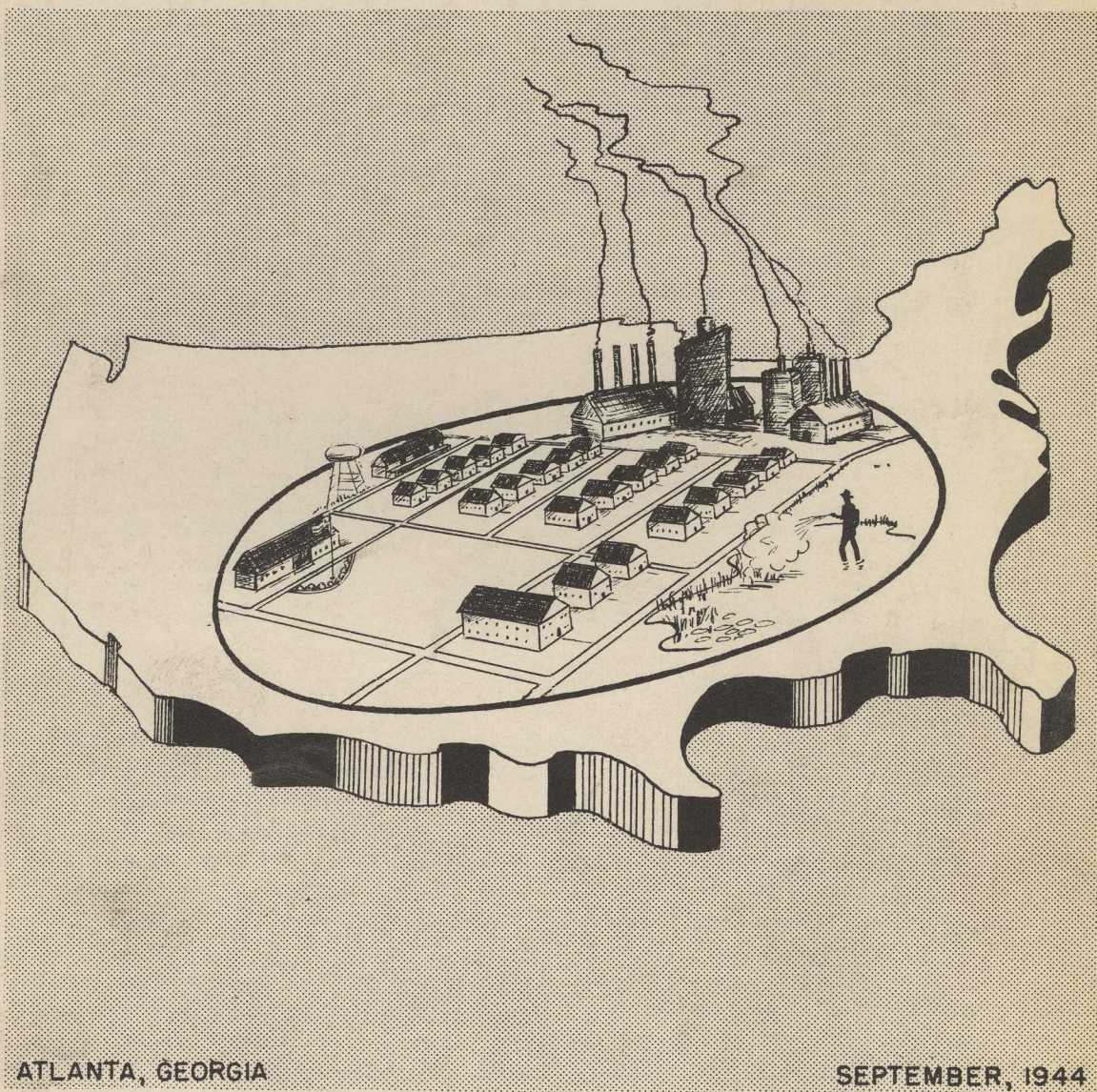




FIELD BULLETIN

IN-SERVICE TRAINING AND INFORMATION

MALARIA CONTROL IN WAR AREAS



ATLANTA, GEORGIA

SEPTEMBER, 1944

AN ANOPHELINE SURVEY IN NEW MEXICO

PUMPS FOR MALARIA CONTROL IN PUERTO RICO

MALARIA CONTROL IN SWAMP AREAS

FEDERAL SECURITY AGENCY U.S. PUBLIC HEALTH SERVICE

Courtesy of the David J. Sencer CDC Museum

RESTRICTED

TABLE I
MOWA LARVICIDE, MINOR & MAJOR DRAINAGE WORK
AUGUST 1 - 31, 1944

STATE	Areas in Operation	War Estab- lish- ments Pro- tected	LARVICIDAL WORK				DRAINAGE OPERATIONS											Total Man Hours
			Larvicide Used		Surfaces Treated		Clearing	Cleaning	New Ditching		Ditch Lining		Underground Drainage Lin.Ft.	Fill Cu.Yds.	Water Surf. Eliminated Acres			
			Oil Gals.	Paris Green Lbs.	Oiled Acres	Dusted Acres			Lin.Ft.	Dynamite	Total Cu.Yds.	Lin.Ft.				Sq.Ft.		
																	Removal Surf.Veg. Acres	
Alabama	7	93	1,036	196	48	106	7.4	0.1	962,200	5,550	---	---	---	---	---	---	4.5	8,703
Arkansas	15	93	24,787	658	1,652	455	104.7	---	342,566	1,400	---	---	---	---	---	---	---	31,148
California	4	30	7,038	72	649	45	3.0	2.3	84,532	677	---	---	---	---	---	---	7.5	6,352
D. C.	1	22	---	---	---	---	0.1	---	1,206	---	---	---	---	---	---	---	---	845
Florida	18	113	7,965	220	423	651	56.0	4.4	1,550,981	27,781	---	---	---	16	6,574	18.3	37,806	
Georgia	14	106	395	3,046	21	2,397	23.5	0.8	232,588	14,749	---	---	---	---	937	11.5	27,858	
Illinois	2	54	4,373	312	166	321	1.4	---	---	975	---	---	---	---	---	---	---	4,781
Indiana	2	38	2,987	30	290	34	---	---	7,000	---	---	---	---	---	---	---	---	3,297
Kansas	1	20	305	41	15	20	3.9	6.4	---	---	---	---	---	---	---	---	---	1,041
Kentucky	5	48	2,371	93	153	77	17.2	0.1	11,580	60	---	---	---	---	---	---	---	8,444
Louisiana	8	86	77,124	65	3,831	30	76.1	0.4	688,276	14,218	---	---	---	---	1,692	5.4	74,460	
Maryland	1	32	---	156	---	116	0.5	---	42,113	550	---	---	---	---	---	---	---	3,069
Massachusetts	--	4	1,112	105	89	95	0.1	---	---	---	---	---	---	---	---	---	---	1,810
Michigan	2	5	84	94	8	93	1.4	---	---	---	---	---	---	---	---	---	---	1,232
Mississippi	17	60	15,496	409	540	254	95.4	0.4	679,835	2,349	---	---	---	---	---	0.1	28,488	
Missouri	7	22	7,991	2,102	1,097	738	3.4	---	9,020	2,395	---	---	---	---	---	0.1	9,615	
New York	--	4	519	243	26	50	3.5	---	7,920	7,030	11,080	---	---	---	---	---	---	11,939
North Carolina	10	82	5,094	13	282	14	247.6	3.2	843,159	31,903	---	---	---	---	---	2.9	42,928	
Oklahoma	9	62	14,724	275	981	253	9.5	0.1	900	1,335	---	---	---	---	---	6.0	15,954	
Oregon	1	7	1,252	---	40	---	---	---	---	---	---	---	---	---	---	---	---	969
Puerto Rico	5	22	5,876	7,404	194	3,400	9.0	---	870,316	12,567	---	---	24	180	---	1.2	55,061	
South Carolina	21	116	14,267	214	961	196	319.8	0.3	1,796,915	32,744	---	---	1,645	6,972	7.1	---	61,437	
Tennessee	6	68	11,882	154	562	185	1.9	---	44,310	283	---	---	---	---	---	---	---	15,378
Texas	13	178	10,753	280	595	260	154.9	0.9	455,000	5,933	1,300	---	---	60	2.3	---	48,835	
Utah	--	6	---	75	---	84	---	---	200	360	---	---	---	---	---	---	---	622
Virginia	4	94	7,161	9,023	164	1,788	61.6	1.6	21,156	12,617	---	---	52	12	---	---	27,923	
Total	173	1,465	224,582	25,280	12,777	11,652	1,201.9	21.0	8,651,773	175,476	12,380	2,440	3,080	9,140	17,263	66.9	529,965	
July Total	171	1,434	200,117	22,921	12,634	10,685	1,229.0	33.6	8,206,552	211,327	19,781	1,775	3,102	8,894	12,386	283.9	---	522,257

AN ANOPHELINE SURVEY in New Mexico

By Asst. San. (R) M. H. Goodwin

During investigations in the vicinity of prisoner-of-war camps and other military installations in New Mexico, an opportunity was afforded to study *Anopheles* mosquito breeding places representative of the various sections of the Southwest. Previous reports by U.S. Public Health Service investigators indicated that several areas were favorable for the production of malaria-carrying mosquitoes in this region. Two surveys were conducted this year, one in May at the beginning of the *Anopheles* breeding season, and another in August when breeding had reached its peak. Thus it was possible to examine many situations twice under different conditions.

Since *Anopheles* breeding and concentrations of human population are almost always associated with river valleys, these valleys are a convenient means of designating sections of the State for purposes of malaria control. The important river systems are shown in figure 1.

ANOPHELINE BREEDING PLACES

In arid regions most of the potential mosquito-breeding places are man-made. These include irrigation systems and natural sources of water, such as springs, or wells, which are modified for domestic use. Large rivers also may be important sources of anopheline production. However, most of the drainage ways in New Mexico are arroyos which have very brief, intermittent, torrential flows. These do not provide suitable breeding places for *Anopheles* mosquitoes. Hydroelectric and irrigation impoundments are unfavorable because in this area they invariably accumulate a deposit of alkali. Retention of water in large reservoirs also eliminates ponded areas in the lower portions of rivers.

The proven malaria vector in New Mexico is *Anopheles freeborni* Aitken. This spe-

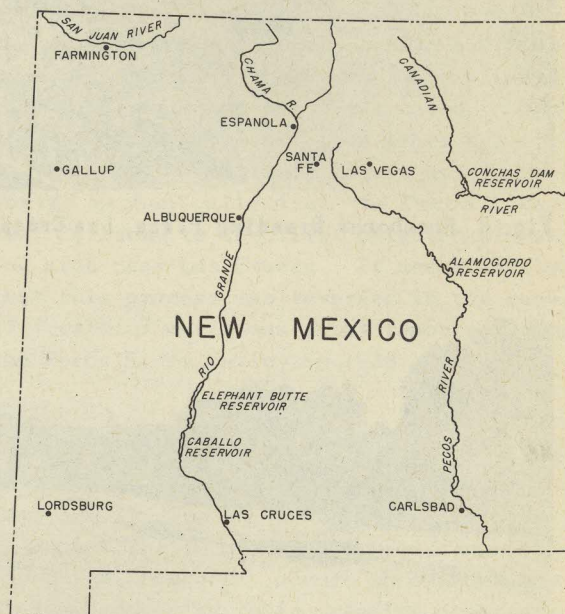


Fig. 1. Principal River Valleys of New Mexico

cies usually shows a preference for densely shaded areas such as are formed when the flow of water in rivers or ditches is negligible. Under these conditions tall emergent vegetation becomes established and may become so matted that it is impossible to dip for larvae until some of the vegetation is removed (Fig. 2).

Anopheles pseudopunctipennis franciscanus McCracken is likewise widely distributed over the State. Typical *pseudopunctipennis* occurs southward in Central and South America. It extends at least as far north as Southern Texas. *Franciscanus*, on the other hand, is a Pacific Coast form which, on the basis of the present surveys, extends southeastward throughout New Mexico. In contrast to *freeborni*, *franciscanus* breeds in open, sunny situations (Fig. 3). It often occurs in water which is actually hot to the touch. Emergent vegetation and even sparse shade are avoided.

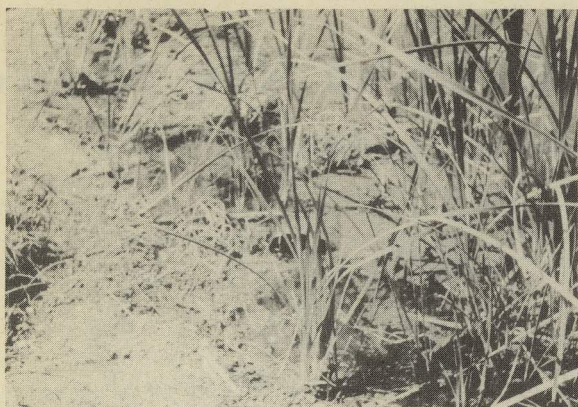


Fig. 2. *Freeborni* Breeding Place, Las Cruces

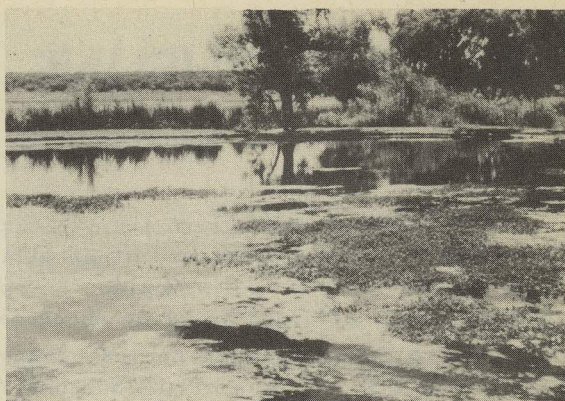


Fig. 3. *Franciscanus* Breeding Place, Carlsbad



Fig. 4. Chama River Showing Isolated Pools

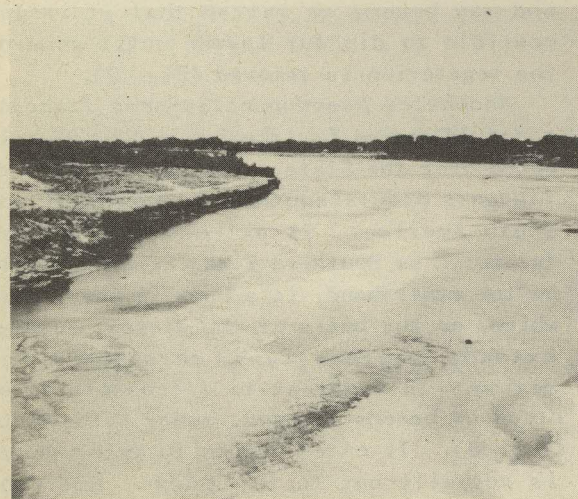


Fig. 5. Pecos River without Breeding Places

RIVERS

Rivers encountered are of two general types. One type with extremely rocky river beds, such as the Chama River (Fig. 4), contains many depressions likely to hold water after flow of the river has stopped. These isolated pools become covered with algal growth and provide conditions favorable for *franciscanus* breeding. No *freeborni* were encountered in such situations. The second type is represented by the Rio Grande, Pecos and other rivers. These have a sandy, porous bed which has little tendency to hold water after the main flow has stopped (Fig. 4). Only at the point of entrance of springs into a main river does algal growth occur and provide a place for *franciscanus* breeding (Fig. 5).

IRRIGATION AND DRAINAGE SYSTEMS

Irrigation systems are responsible for a majority of the most important *Anopheles freeborni* breeding areas in New Mexico. Water is diverted from the large rivers and is used to inundate the cultivated fields. Storage of this water, and its subsequent release, provide a marked diurnal variation which does not permit the establishment of aquatic plants. An excess of water is always applied to the fields and subsequently drained off to prevent the formation of alkali, which is extremely harmful to the land. On the other hand drainage ditches have a very sluggish flow, and are not subjected to wide fluctuations as are the irrigation ditches. Consequent-

ly, these are virtually overgrown with tall emergent cane and other herbaceous plants. These ditches provide ideal breeding situations for *Anopheles freeborni* (Fig. 7).

In the northwestern part of the State irrigation of the cultivated portion of the San Juan River Valley is somewhat different. Cultivated fields are located fairly high above the river on mesas. No attempt is made to collect the excess irrigation water and carry it to the river in ditches. Water is drained from the fields and then allowed to spread over the hillsides and river flood plain. Consequently, extensive shallow seepage areas are encountered which are very prolific producers of *Anopheles freeborni*. In contrast to the breeding areas encountered in other sections of the State, these situations are only sparsely shaded by short, semi-aquatic grasses. Water in these places is not deep and *Anopheles freeborni* larvae occur in even the slightest depression.

DISTRIBUTION AND DISPERSAL

Identification of *A. freeborni* in the southern part of the State is difficult because of the concurrence of *Anopheles punctipennis* (Say). At present these species are not distinguishable in the larval stage and it is necessary that specimens be reared for positive identification. *A. punctipennis* has been reported only from

the Carlsbad and Las Cruces areas.

Obviously the *Anopheles* breeding areas in this State are widely separated because of the sparsity of suitable watered areas. Dispersal or spread of breeding is not by natural encroachment except within a specific valley. Dispersal from one valley to another probably occurs only by human agency. For example, *punctipennis* has been known to occur in the Pecos Valley for a number of years but was first noted in the Rio Grande Valley about five years ago. It is very likely that this insect was transported mechanically from the Pecos River near Carlsbad to the first detected breeding area near Las Cruces. It seems likely that this process was reversed in the case of *freeborni* which was first reported from the Pecos River Valley in 1938.

SUMMARY

To summarize, anopheline breeding in New Mexico is confined to the river systems and is usually associated with irrigation. The principal malaria vector, *Anopheles freeborni*, occurs throughout the State wherever suitable breeding areas are encountered. *Pseudopunctipennis* is also generally distributed wherever conditions are suitable but only the apparently benign subspecies *franciscanus* was found. The only other anopheline collected was *punctipennis* and this was limited to the Carlsbad and Las Cruces areas.

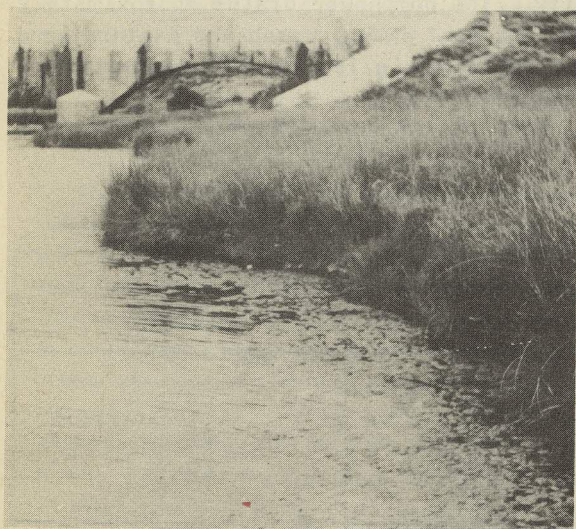


Fig. 6. *Franciscanus* Breeding Place, Pecos R.



Fig. 7. *Freeborni* Breeding Place in Ditch

PUMPS FOR MALARIA CONTROL *in Puerto Rico*

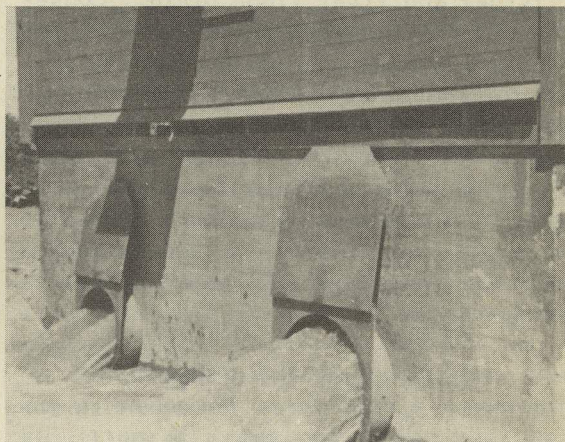
By Sr. San. Engr. (R) J. M. Henderson and P. A. San. Engr. (R) A. H. Neill

Topographic and ground water conditions in Puerto Rico have necessitated the extensive use of pumps throughout the MCWA program. Pumps are used (a) for temporary pumping of ditches, canals and foundation excavation during construction, (b) for dewatering small landlocked ponds (portable ditch pumps) and (c) as permanent pump installations for dewatering coastal swamps and marshes lying at or below sea level.

Pumping during drainage construction (Item a) is extensive because much of the work is below sea level and also because numerous lime springs are encountered within excavation sections. Both diaphragm and centrifugal type motor driven portable ditch pumps have been used, the latter ranging in size from 1½ to 8 inches. In the second category (Item b), pumping of selected permanent lime sinks with steep, high banks and limited watersheds has been practiced.

Two permanent pumphouses in the third category were installed. One, completed in 1944, consists of three low lift centrifugal pumps, each having a capacity of 30,000 gallons per minute. This was built by the Army Engineers as an element of a comprehensive extra-reservation malaria drainage project prosecuted jointly by MCWA and the Army. Since installation, these pumps have at times been taxed to their total capacity of 90,000 gallons per minute. The second pumphouse, built by MCWA with assistance from the Insular

Health Department, WPA, FWA and several Army organizations, was completed in the summer of 1943. The pumps were operated until December, when the affected Army post was temporarily abandoned. Operation was resumed on May 8, 1944, due to reestablishment of the post. The installation comprises two pumps rated at 20,000 and 10,000 gallons per minute, which are oper-



Losey Field Pumping Station

ated by a 50 and a 20 horsepower electric motor respectively. Each pump has a static lift of 4½ feet but the total dynamic head of the two pumps differs slightly, due to differences in design and capacity. The pumphouse drains approximately 400 acres of swamp, marsh and pasture land, all of which is less than two feet above mean sea level.

Unit energy consumption is affected by

Record of Pump Operation since Reestablishment of the Post

Month	Million Gallons Pumped	KW Hr. Consumed	KW Hr. per Million Gallons
May, 1944	78	1,060	13.6
June, "	56	880	15.7
July, "	48	800	16.7
August, "	95	2,060	21.7
Total	277	4,800	17.3

several factors, mean water elevation at the pump intakes being the principal one. When surface flood water resulting from distant rains and overflow of a river passing through the drained area is being removed, the water elevation on the suction side of the pumps is high and the

lift and energy consumption per million gallons of water is reduced. Conversely, when continued pumping is required to remove local rainfall which seeps slowly into the drained area, the mean water level in the inlet reservoir is low and unit energy consumption increases.

MALARIA CONTROL *in Swamp Areas*

By P. A. San. Engr. (R) C. A. Hansen

In many instances malaria control in areas surrounding military establishments has been a problem of controlling the breeding of *Anopheles quadrimaculatus* in swamps adjacent to streams. In coastal regions, streams seldom have clearly defined channels. This results in the flooding of large sections of bottom land greatly increasing the area in which breeding may occur and in which control may be necessary.

Anopheline control by means of larviciding is often difficult in this type of area because of its wooded character and dense vegetation which interfere with the dispersion of paris green dust. This type of area is often inaccessible from the standpoint of oiling operations.

An economical method of anopheline control under these conditions consists of improving and clearing the stream channel to accomplish rapid removal of water and to reduce the extent of the flooded area. The work generally consists of removing log jams and debris, cutting new channels across U bends and grading old bayous to drain, as shown in figure 1.

This solution of the problem makes possible satisfactory anopheline control with an expenditure of approximately 1/10 of that which would be required to re-channel the entire waterway. A typical illustration is the Congaree, South Carolina area where the water level in a swamp was lowered approximately three feet, thereby confining the water to the main channel. Ponds created by seepage from hillsides around the swamp were eliminated by construction of small contour ditches. The

main channel was cleared of all obstructions and short bends were cut off by blasting new sections with dynamite. After this project is completed only a small amount of larviciding will be needed to control anopheline breeding in isolated pools and seepage areas that cannot be drained economically. The cost of this project will be amortized in about two years by the saving in larviciding.

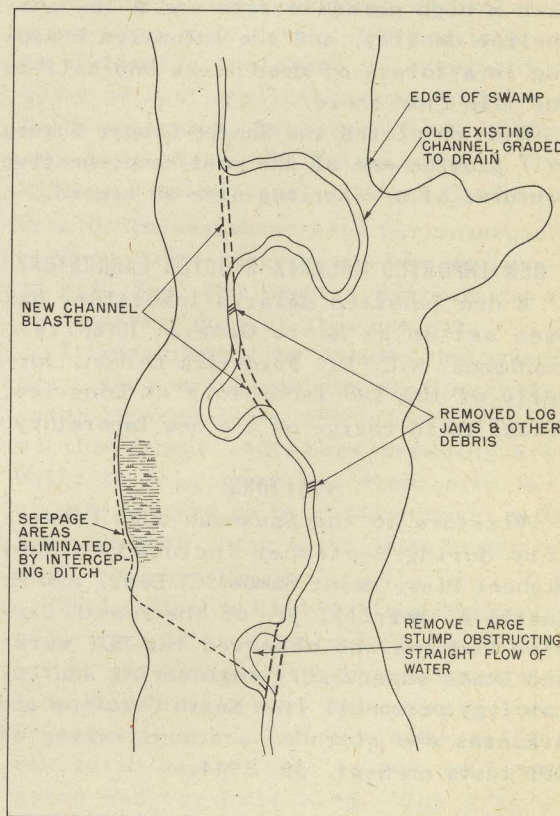


Fig. 1. Malaria Control by Channel Clearing

HEADQUARTERS NOTES



SANTEE-COOPER SURVEY

The Santee-Cooper Survey is a joint undertaking of the South Carolina State Board of Health and the U.S. Public Health Service. The Survey consists of (1) blood surveys conducted by a house-to-house canvass of the region; (2) maps prepared to show the location of breeding areas; (3) anopheline density data determined by sampling standardized mule-shed collecting places; (4) host preference data determined by gathering large numbers of engorged females to be examined by precipitin test; (5) records of the rate of infection of mosquitoes determined by recording the number of oocysts on mosquito stomachs; and (6) data on dispersal flights obtained by marking anophelines and recapturing them after flight. Of special interest at present are the relatively high parasite index in some areas, the relatively high rate of oocyst infection in regions with a high parasite rate and a low anopheline density, and the intensive breeding in a forest of dead trees one-half to one mile from shore.

When completed the Santee-Cooper Survey will provide one of the most comprehensive pictures of a malarious area on record.

NEW IMPORTED MALARIA STUDIES LABORATORY

A new Imported Malaria laboratory has been set up at Moore General Hospital, Swannanoa, N.C. Dr. Frederick Ehrman, formerly of the IMS laboratory at Longview, Texas, is in charge of the new laboratory.

VISITORS

Visitors to the Savannah MCWA Laboratory during September included Colonel Michael Blew, Major Samuel C. Dews, and Mr. Austin W. Morrill, Jr. of the Fourth Service Command who observed the DDT work; and State supervisory engineering and entomology personnel from North Carolina and Arkansas who attended a demonstration of DDT tests on Sept. 29, 1944.

SURVEY OF DENISON DAM IMPOUNDMENT

A preliminary reconnaissance was made

of existing conditions as related to the malaria hazard in the vicinity of the Denison Dam Impoundment. P. A. Surg. B. K. Milmore and P. A. San. Engr. (R) C. A. Hansen conducted the survey from August 31 to September 6, 1944. When the impoundment reaches normal operating level it will cover approximately one-hundred and forty square miles with a shore line of approximately 1250 miles. Three-fourths of the impoundment is in Oklahoma and one-fourth in Texas.

The lake will not reach normal operating level until late spring of 1945 but the preliminary survey shows the need for an organization to deal with malaria and other public health problems that may arise in connection with the impoundment and subsequent recreational facilities. Specifically there appears to be a need for a comprehensive survey including blood slide data, adult mosquito densities, and maps showing mosquito breeding areas and the location of the human population. Removal of 60 acres of original timber and clearing of considerable second growth vegetation is also needed before the anticipated rise of 22 feet in lake level.

PROFESSIONAL PERSONNEL

Jr. Asst. San. (R) Wayne R. Shepherd and Asst. Engr. (R) G. L. Jacobsen were commissioned recently and called to active duty. In addition, four Junior Public Health Engineers, Albert E. Low, Richard G. Hastings, Jr., Lloyd O. Leslie and Irwin R. Holmes, reported for active duty.

Transfers include Asst. San. (R) Harvey I. Scudder from Montgomery, Ala. to Savannah, Ga.; Asst. Engr. (R) John R. S. Hill from Florence, South Carolina, to San Juan, Puerto Rico; Asst. San. (R) Wilbur H. Duncan from Charleston, South Carolina to Headquarters; Asst. San. (R) Bertram Gross from the Florida *Aedes aegypti* program to the Hawaiian Dengue Control project; Asst. San. (R) Gordon W. Ludwig from Norfolk, Virginia to the Tennessee Valley Authority, Wilson Dam, Ala.; Asst. Engr. (R) H. Melvin Giges from Ft. Worth, Texas, to Headquarters; and P. A. Engr. (R) Curtis G. Humphreys from Tampa to Jacksonville, Fla.

DIVISION NOTES



AEGYPTI SURVEYS IN NON-PROJECT CITIES

Asst. San. (R) Wilbur Duncan will supervise two field teams conducting *Aedes aegypti* surveys in non-project cities. Survey personnel will be borrowed from existing projects. Surveys are primarily for the purpose of evaluating the *aegypti* hazard in cities near important military establishments in the Southern States.



TIME-COST STUDIES

P.A. San. Engr. J. G. Terrill, Jr., is making resident time-cost studies on selected projects in cooperation with P.H.S. District offices and with the States. Each study will last from 4 to 6 weeks. These studies consist primarily of a detailed time analysis of individual labor crews in order to determine unit rates of accomplishment on various types of larviciding projects and on clearing, cleaning and minor drainage projects.

Because of the lateness of the season work has been limited in extent but projects are being studied in Virginia, North Carolina, Florida, Mississippi, and Louisiana. Time-cost studies are being conducted to make possible more accurate engineering estimating and to discover what changes can be made in methods and equipment to increase the efficiency of control operations.



MEDICAL DIVISION

In an attempt to evaluate the complement fixation test for malaria, Medical Director J. F. Mahoney and Surgeon V. B. Link have arranged to study the specificity of the test by examining blood samples collected from a large number of people who have never been exposed to malaria.



NEW QUARTERS FOR THE TRAINING DIVISION

Consolidation of all training, photographic, and reports activities has been effected by moving to new quarters across the street from the Volunteer Building.

DOCUMENTARY FILMS

Documentary films were made of general

control operations at Dyersburg, Tennessee, and McGehee, Arkansas; pole drainage at Paris, Tennessee; DDT treatment of irrigation water at Stuttgart, Arkansas; airplane dusting at Walnut Ridge, Arkansas; community education work at Sumter, South Carolina; and TVA mosquito proofing at Paris, Tennessee.

OFFICE PERSONNEL TAKE IN-SERVICE TRAINING

Eighteen CAF employees in the Headquarters office attended two morning sessions of the In-Service Training course. The history and general organization of MCWA was outlined and brief illustrated accounts were given of the entomological, engineering and medical aspects of malaria control and of the *Aedes aegypti* control program.



AIRPLANE DUSTING IN TEXAS

On August 8 an airplane dusting program was initiated in the Orange and Beaumont Zones near Port Arthur, Texas. Actual dusting operations consumed little more than a day, but a thorough entomological survey was made during the previous week to determine the areas of treatment and rates of dust application required for effective control. Asst. San. (R) I. J. Ogden and Asst. San. (R) Dale Lindsay, Texas MCWA entomologists, and Area Supervisor Donald Schliessmann, with his inspectors, conducted the survey with the assistance of P.A. San. (R) Herbert Knutson who was on temporary duty at this project.

It was interesting to note that *quadrimaculatus* was breeding profusely in a large cypress swamp which comprised half of the marshy 1400-acre breeding area. Water in this swamp was clear rain-water or water backed up by tidal action, rather than the dark, acid water often encountered in cypress swamps.

While dusting the flat marsh the airplane flew at an elevation of 6 to 10 feet, but it was necessary to increase the altitude to 100 feet over the cypress trees. Because of this high altitude the dust mix ratio was altered to one-half paris green and one-half lime. The area was dusted with lighter applications because of the concentrated mixture.

LITERATURE REVIEW



MOSQUITO CONTROL. By W. B. Herms and H. F. Gray. 2nd. Edition pp. xiv+419. The Commonwealth Fund, New York. 1944. Price \$3.50.

This general account of mosquito control methods first appeared in 1940. A thoroughly revised and enlarged second edition was necessitated by the "rapid development of new techniques of mosquito control in the past three years."

The authors have drawn on their wide experience, Dr. Herms as a Lt. Col. (ret.) in the U. S. Army Sanitary Corps and Professor of Parasitology at the University of California and Mr. Gray as Director of the Alameda County (Calif.) Mosquito Abatement District, consulting civil engineer, and lecturer in public health at the University of California.

Mosquito Control opens with a general introduction and historical account and a discussion of the importance of mosquitoes. There follows a detailed analysis of the "Laws and Agencies for Mosquito Abatement". Federal, state, county and city programs are discussed. The New Jersey and California laws are analyzed and compared with the laws of Utah, Illinois, Rhode Island, Mississippi, Florida, New York and Connecticut.

The chapter on "Preliminaries to Abatement Procedures" enumerates the steps to be taken in setting up a mosquito abatement district. These details will be a great aid to communities in planning their mosquito control programs. Education is treated in the following chapter, as an integral part of any tax supported program. Leaflets and other educational material are reproduced from the Alameda County Abatement District where a full time public relations man has been employed for a number of years.

Entomological aspects of mosquito control are discussed in the chapter entitled "Finding Mosquito Breeding Places." Such sampling methods as hand collecting in cyanide and chloroform tubes, collecting in a sucking tube or aspirator, trapping mosquitoes in light traps and bait traps, and

dipping for mosquito larvae are described. The discussion of light traps is particularly full. Application of these sampling techniques is then discussed under "Preliminary Surveys", "District Inspection", "Inspections following Complaints", and "Follow-up Inspections."

Mosquito abatement methods are described under a general chapter followed by specific chapters on "Drainage and Reclamation of Fresh-water Marshes; Drainage and Reclamation of Salt-water Marshes; Filling, Pumping and Flushing; Oils and Larvicides; Methods of Application of Oils and Larvicides; and Mosquito Control by use of Fish".

Supplementary protective measures such as screening, repellents, and killing of adult mosquitoes are discussed in some detail. Special sections are devoted to "Mosquitoes and Aeroplanes", "Military Malaria Control", and to "Wild-life Conservation and Mosquito Abatement."

Innumerable special problems and unusual situations are encountered in the course of a mosquito control program. Some of these are treated under chapters entitled "Special Features of Mosquito Control in Urban Areas" and "Special Features of Mosquito Control in Rural Areas". Species sanitation, species eradication, and naturalistic methods of mosquito control are discussed in the last chapters of the book.

Valuable reference material is added in the appendixes including (a) the distribution and typical breeding places of the principal anophelines of the world; (b) similar information for the mosquito vectors of yellow fever, dengue, filariasis, and epidemic encephalitis; (c) a "Classification of Mosquito Abatement Methods"; (d) keys, charts, and diagrams for the identification of mosquito larvae and adults; and (e) a "Selected List of Books and Articles on Mosquito Species and Biology".

Work of the U.S. Public Health Service is well represented and illustrated by many photographs and seven plates. These include copies of report forms, circular and pictorial keys, and a series of pictures of dynamite ditching.

TABLE II
MCWA EXPENDITURES AND LIQUIDATIONS BY MAJOR ITEMS
AUGUST 1944

	Continental U. S.	Percentage of Total	Puerto Rico	Percentage of Total
.01 Personal Services	\$ 459,116.56	84.21	20,596.30	88.14
.02 Travel	22,464.12	4.12	146.00	.62
.03 Transportation of Things	2,141.19	.39	--	--
.04 Communication Services	1,019.16	.19	11.00	.05
.05 Rents and Utilities	1,985.47	.36	--	--
.06 Printing and Binding	1,447.82	.27	--	--
.07 Other Contractual Services	4,169.75	.76	--	--
.08 Supplies and Materials	39,270.21	7.21	2,614.68	11.19
.09 Equipment	13,589.18	2.49	--	--
Total	\$ 545,203.46	100.00	23,367.98	100.00
Expenses other than Personal Services	\$ 86,086.90	15.79	2,771.68	11.86

TABLE III
MCWA PERSONNEL ON DUTY AND TOTAL PAYROLL
AUGUST 1944

State	Commissioned		Prof. & Sci.		Sub-Prof. (1)		C. A. F.		Custodial and Per Hour		Total		Percent of Total	
	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay
Alabama	4	1,104	1	263	3	364	2	403	36	4,017	46	6,151	1.42	1.28
Arkansas	8	2,432	7	1,790	30	6,053	4	794	158	20,392	205	31,461	6.33	6.56
California	3	855	--	---	6	1,298	3	623	22	3,642	34	6,418	1.05	1.34
Dist. of Columbia	1	333	--	---	3	617	1	233	3	487	8	1,670	.25	.35
Florida	6	1,847	4	1,463	20	3,842	6	1,006	190	25,110	226	33,268	6.98	6.93
Georgia	7	2,112	3	730	39	7,683	6	987	99	12,673	154	24,185	4.75	5.04
Illinois	6	1,697	1	203	3	548	3	635	18	2,349	31	5,432	.96	1.13
Indiana	2	570	--	---	2	365	--	---	12	1,541	16	2,476	.49	.52
Kentucky	4	1,199	2	537	11	2,822	2	310	20	2,986	39	7,854	1.20	1.64
Louisiana	10	2,925	4	1,221	47	9,380	6	988	316	41,461	353	55,975	11.83	11.67
Maryland	2	533	--	---	3	670	2	438	12	1,536	19	3,177	.59	.66
Mississippi	6	1,759	3	801	12	2,453	4	566	98	13,273	123	18,832	3.80	3.93
Missouri	3	1,000	--	---	14	2,737	4	726	32	4,412	53	8,875	1.64	1.85
North Carolina	6	1,807	4	1,279	12	2,364	4	726	193	24,967	219	31,143	6.77	6.49
Oklahoma	5	1,500	1	264	13	2,504	2	224	60	8,082	81	12,574	2.50	2.62
Oregon	--	---	1	264	1	203	--	---	--	---	2	467	.06	.09
Puerto Rico	9	3,723	4	944	1	296	6	1,079	326	14,553	346	20,595	10.69	4.29
South Carolina	8	2,269	6	1,463	35	7,091	9	984	266	34,513	324	46,320	10.01	9.66
Tennessee	4	1,140	3	841	5	1,217	3	584	64	8,388	79	12,170	2.44	2.54
Texas	7	2,004	4	1,289	26	5,848	6	990	213	27,172	256	37,303	7.91	7.78
Virginia	3	891	2	696	21	4,494	3	603	120	17,314	149	23,998	4.60	5.00
<u>AEDES AEGYPTI</u>														
Alabama	1	285	--	---	7	1,538	1	147	--	---	9	1,970	.28	.41
Florida	2	570	1	274	36	6,236	2	489	--	---	41	7,569	1.27	1.58
Georgia	1	285	--	---	9	1,700	--	---	--	---	10	1,985	.31	.41
Louisiana	1	285	1	284	17	3,061	1	164	1	125	21	3,899	.65	.81
South Carolina	--	---	--	---	11	1,852	1	164	1	135	13	2,151	.40	.45
Texas	5	1,393	1	141	30	5,493	2	310	3	477	41	7,814	1.28	1.63
Hq. & Dist. (2)	76	24,555	12	3,412	44	8,596	113	19,313	19	2,825	264	58,701	8.17	12.24
Mobile Units	1	285	--	---	6	1,045	--	---	37	3,949	44	5,279	1.37	1.10
Total	191	59,358	65	18,139	467	92,350	196	33,486	2,317	276,379	3,236	479,712	100.00	100.00
Percent of Total	5.90	12.37	2.00	3.78	14.43	19.25	6.06	6.98	71.61	57.62	100.00	100.00		

(1) Includes Entomological Inspectors

(2) Includes Headquarters and District Offices, malaria survey, Imported malaria control, special investigations, and employees temporarily attached to Headquarters pending assignment to states.

MALARIA CONTROL IN WAR AREAS

LINES OF AUTHORITY AND INTERRELATIONS

